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Pain Radiation along the Path of the Nerve

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Abstract

Sciatica with or without nerve injury can present with weakness. Those with sacroiliitis and greater trochanteric pain syndrome commonly have lower extremity weakness. In these cases, weakness may be mediated by nociceptive signals from damaged or inflamed joints, a concept called arthro-genic inhibition. Sensory loss is most often a sign of neuropathic sciatica, but it can also occur in somatic referred sciatica.

Keywords: Neurons; Nerve; Innervates; Artery; Genesis; Dermatomes

Introduction

One study found that almost half of non-radicular sciatica cases verified by imaging or electro-diagnostics had subclinical sensoryloss. This sensory loss was identified by quantitative sensory testing, an advanced and sensitive tool. Another study found patients with sacroiliitis had lower extremity sensory loss. Sensory loss in non-radicular sciatica could relate to inflammatory changes of the lumbosacral plexus or sciatic nerve trunk, or changes to the central nervous system such as cortical reorganization [1]. Neuro-dynamics helps explain how sciatica can occur in the absence of nerve damage. Neuro-dynamics is the study of the mechanics and physiology of the nervous system and how these components relate to one another. Patients may have multiple contributing factors that increase mechanical sensitivity and tension along the sciatic nerve. For example, one may have a gluteal muscle contracture, hamstring tendinopathy, and anterior head posture. A combination of conditions is more likely produce sciatic pain than any individual factor. The distribution of sciatica is one indicator of its underlying pathology [2]. The pain or symptom pattern can help identify one or more nerve distributions, referred pain from joints, viscera or fascia, or a combination of factors. Pain patterns by themselves are unreliable. Clinicians should interpret the distribution of symptoms in context with other clinical findings for a more accurate diagnosis. The sensory distribution of the sciatic nerve is distinct from the sensory distributions of the lumbosacral nerve roots. It includes more than half of the area distal to the knee, including the leg and foot, but not the medial leg or arch of the foot. Pain affecting the distribution of the sciatic nerve below the knee may indicate a sciatic nerve trunk lesion. The best example of this pattern is piriformis syndrome.

The nerve root distributions through overlap with with the sciatic nerve distribution but do not have the same exact territory. These nerve roots branch into other nerves such as the cluneal nerves in the gluteal region and perineum, and the posterior, lateral, and anterior femoral cutaneous nerves of the thigh. The lumbosacral dermatomes are related to, but different than the sciatic nerve distribution. Radicular pain follows a dermatomal distribution, a pattern of skin corresponding to a single nerve root. An inflamed or compressed nerve root may cause pain, numbness, or other sensations in the skin of the nerve root's sensory distribution. Patients with radicular sciatica seldom have symptoms of an entire single dermatome. More than half of patients with radicular sciatica have pain in a partial dermatome.

Discussion

Radicular sciatica includes lesions of the nerve roots, which contribute to the sciatic nerve sensory distribution. Although contributions to the sciatic nerve, its sensory part comes from the perineal nerves which do not connect to the sciatic. The most common forms of radicular sciatica affect; these make up over 90% of cases of radicular sciatica. Degenerative spinal conditions may damage more than one nerve root, either on the same side or both sides of the body. Lumbar disc herniations affect one nerve root in 60% of cases and two in 40%. Degenerative lumbar spondylolistheses affect two or more nerve roots in 90% of cases [3]. Involvement of more than one nerve root creates a broader symptom distribution that may span multiple dermatomes. Sciatic nerve trunk pain is deep pain along the trunk of the sciatic nerve that increases with pressure and stretch. This type of pain is thought to arise from the nervi nervorum, the small nerves that innervate the sciatic nerve sheath. Injury or inflammation along the sciatic nerve pathway make the nervi nervorum more sensitive to pain The two categories of referred pain are somatic referred pain and visceral referred pain. This type of pain accounts for nearly one-third of cases of sciatica. This pain is explained by neurological mechanisms most likely involving the dorsal horn of the spinal cord. In referred sciatic pain there is no lumbosacral nerve root or sciatic nerve injury that directly causes sciatica. Referred pain follows a highly variable pattern compared to radicular or in-traspinal sciatica.

Injury and inflammation of joints, soft tissue, and viscera may refer pain into their corresponding segmental level. The patient then perceives pain as coming from a healthy area. Pain can refer into part of a single segment or multiple segments of derma-tome or sclerotome. Somatic referred sciatica arises from sensitive structures such as the hip and sacroiliac joints, gluteal tendons, and even the intervertebral disc. An annular tear in the disc may cause referred sciatic pain while leaving the nerve root intact. Hip arthritis may cause sciatic pain because the hip is innervated by the sciatic nerve. Injury to any structure innervated by the nerve roots that make up the sciatic nerve could cause somatic referred sciatic pain. Non-sciatic nerve injuries that refer pain into a larger distribution are forms of somatic referred sciatic pain [4]. These

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include cluneal nerve entrapment and dorsal ramus syndrome. These nerves have a small distribution, but when entrapped or injured can refer into a much broader area of the thigh and/or leg.

Visceral pathology as a cause of sciatica is less common but may occur when sensory signals converge with those of the sciatic and posterior femoral cutaneous nerve at the spinal segments. In viscera-somatic convergence sensory signals interact at the dorsal horn of the spinal cord. Referred pain may occur in a vague, deep segmental sensory distribution called sclerotomes. Sclerotomes are the segments of bone, periosteum, ligaments, tendons, and joint capsules that relate each to a single spinal nerve root. The sclerotomes are analogous to the dermatomes (skin) and myotomes but are less distinct and less understood. The few specific regions include the lateral malleolus and dorsal ankle. The sciatic nerve is the longest, widest, and thickest peripheral nerve in the body. It originates from the lumbosacral plexus at the base of the spine then passes through the pelvis into the posterior thigh. The sciatic nerve and its branches innervate about Therefore the children of Israel eat not of the sinew which shrank, which is upon the hollow of the thigh, unto this day because he touched the hollow of Jacob's thigh in the sinew that muscles on each side of the body, more than any other nerve. Authors from the 1400s CE and earlier described the sciatic nerve. It is difficult to determine a precise date of discovery for the sciatic nerve because ancient languages typically equated nerves with connective tissue [5]. The words nervous in Latin, gid in Hebrew, and irk in Arabic all describe nerves, tendons, ligaments and fascia. The Indian physician Sushruta may have been the first to anatomically describe the sciatic nerves and their relationship to the muscles of the legs and feet and their potential to cause Gridhrasi .Artwork from the 15th century CE supports the notion that the sciatic nerve was discovered by this time. Ancient Judeo-Christian and Native American customs involve removing the sciatic nerve from animals before eating the meat. The Judeo-Christian tradition traces to The Book of Genesis, which describes Jacob's limping and possible episode of sciatica after wrestling with an angel [6]. The Talmud also describes the autopsy on a limping ewe to distinguish between spinal cord damage and sciatica. Some Native American tribes also removed the sciatic nerve from the thigh of animals they killed. Those with an extra thoracic or lumbar vertebra or lumbarisation are more likely to have a post-fixed sacral plexus with a sciatic nerve formed Prefixed or post-fixed variations occur in about 25% of cases [7].

The sciatic nerve has sensory and motor neurons as well as connective tissue, blood vessels, and lymphatic vessels. Its nerve composition is sensory, sympathetic, and motor nerves. A high percentage of adipose tissue protects the sciatic nerve in the buttocks and upper thigh It has more fat and connective tissue in the buttocks, witha ratio of 2:1 fat to tissue, while it is about 1:1 in the mid-thigh and popliteal fossa. Sympathetic neurons travel with the pereneal and tibial branches of the sciatic nerve. These fibers innervate blood vessels in the lower extremity and affect blood vessel constriction and dilation. Increased sympathetic activity is thought to contribute to sciatic pain by activating trigger points and reducing blood flow. Early in embryonic development the sciatic nerves each contain a large sciatic artery which is the main blood vessel to the lower limb buds. The function of this artery is normally replaced by the femoral artery.

Rarely this artery persists into adulthood and predisposes to sciatica. Small nervi nervorum branch from the spinal ganglia, the sciatic nerve and the blood vessels surrounding it [8]. These small nerves innervate the sheath of the sciatic nerve roots and nerve trunk and sense pressure and stretch. Their innervation of the sciatic nerve and roots may explain sciatic nerve trunk pain and neuropathic sciatic pain. The sciatic nerve exits the pelvis through the greater sciatic foramen, usually inferior to the piriformis muscle. It continues downwards nearly mid-way between the ischial tuberosity and greater trochanter of the femur. It descends through the mid-thigh where it is surrounded by the biceps fem-oris, adductor muscles, and lateral inter-muscular septum. The sciatic nerve usually divides internally into the common peroneal and tibial branches which run on a common sheath prior to dividing externally. The tibial division is medial, and the peroneal division is lateral throughout the course of the sciatic nerve [9,10].

Conclusion

The sciatic nerve splits into the tibial and common peroneal branches at the lower thigh or popliteal fossa in people. Occasionally, it separates sooner, within the pelvis, gluteal region, or upper or mid-thigh. Early separation of the sciatic nerve in the pelvis or gluteal region may predispose to nerve compression and cause deep gluteal or piriformis syndromes. The sciatic nerve innervates muscles of the posterior thigh and all muscles of the leg and foot. It innervates all lower extremity muscles except for the gluteal muscles, hip flexors, adductors, and quadriceps. Aside from its cutaneous innervation, the sciatic nerve also provides sensory innervation for lower extremity joints including the postero-lateral part of the hip capsule, lateral knee joint, and ankle.

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Conflict of Interest

None

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